### 3.4.3 Hawaii Region

While the attention of the Hawaii region workshop participants was naturally on the waters surrounding Hawaiian Islands, other areas of interest in the Pacific were identified including Micronesia and Pan-Pacific arcs and trenches. Exploration of the characteristics of microbes in extreme environments and of marine organisms in the water column were noteworthy interest areas in this workshop. A specific interest was the desire to explore trench systems across the Pacific to discover and identify new species. In the local region, participants were interested in the natural history of the islands and expressed a desire for emphasis on marine archeology to preserve the local maritime heritage.

The lack of high-resolution bathymetric maps in the region provided a common talking point in discussing the formulation and identification of exploration needs. The participants also showed interest in reestablishing the Hawaii Undersea Geo-Observatory (HUGO), a submarine observatory located near the summit of Loihi Seamount and connected to the shore via fiber optic cable. HUGO has been inoperative since April 1998. It was identified as a potentially beneficial technological asset for addressing several of the exploration needs developed by the participants.

The results for the Hawaii region workshop are provided in Table 3-5. Exploration targets of interest nominated by participants for the immediate area surrounding the Hawaiian Islands and for broader areas of the Pacific are illustrated in Figures 3-3 through 3-5.

## Table 3-5. Hawaii Region Workshop Results

| Hawaii Workshop | |
|---|---|
| **Standard Package:** Class I/II Vessel with acoustic mapping; Dive capability (ROV/AUV/ Submersible) with imagery/video and sampling equipment; Precise positioning system | **Standard Partners:** University of Hawaii; State of Hawaii; NMFS; NOS; NMS; USCG; Bishop Museum; Hawaii Department of Land and Natural Resources (DLNR); Hawaii Division of Aquatic Resources (DAR); Sea Grant; Hawaii Undersea Research Laboratory (HURL); DOE; Fish and Wildlife Service; Navy Historical Center; National Park Service; USGS; ONR; NSF |

| Hawaii Workshop Results | | | | | | |
|---|---|---|---|---|---|---|
| **ID** | **Category** | **Information Need/Gap** | **What** | **Where** | **Enabling Technologies** | **Partners** |
| 113 | Archeology | Understanding population from geological records | Study fossil records; population over geologic time | Kaneohe Bay | Standard Package | Standard Partners |
| 114 | Archeology | Extinct species (fossil reefs) | Study carbonate samples; date; taxonomy | Deeper the better; NW HI; Emperor Seamount chain; Kure and other seamounts up the chain | Standard Package | Standard Partners |
| 117 | Archeology | Submerged archeological sites | Near-shore low impact visual survey - targeted historical research; archives; non-invasive documentation; Mid-water remote sensing - documentation to narrow down to select survey areas; groundtruth targets; Deep water - survey targeted areas then groundtruth | Kure Island - one of most significant wrecks in Hawaii - Naval Historical Center probably interested in this site; protected zone off Pearl Harbor - several subs there - historic landing sites; Nihoa Island and Necker Island; wider Pacific; US Insular Pacific; Hawaiian Islands - Oahu; big island Hawaii; Kure; Pearl Harbor; Midway; Lanai (shipwreck beach); Midway atoll environs (aircraft); Alenuinui channel between Hawaii and Maui; dumping grounds SW of Barber's Point Oahu; Historic defensive zone outside Pearl Harbor entrance; Areas near shore to Lahaina; Honolulu Harbor; Hilo Bay; Midway atool environs (aircraft); Alenuinui channel between Hawaii and Maui; dumping grounds SW of Barber's Point Oahu; Historic defensive zone outside Pearl Harbor entrance; Areas near shore to Lahaina; Honolulu Harbor; Hilo Bay; Waialua Bay Waialua Bay | Small vessels; side scan sonar; magnetometer; technical and advanced diving; aerial survey or remote sensing; technology dependent on location and type of wreck - later excavation; conservation; and display - need conservation facilities; microbial technologies; microchip technology | Standard plus the following: National Geographic, Discovery Channel, DOI, State Historic Preservation Division, Hawaii Historical Foundation, Hawaii Community Foundation, Bishop Museum, Coastal Maritime Archaeology Resources (CMAR), other small NGO's, Smithsonian |

| Hawaii Workshop Results | | | | | | |
|---|---|---|---|---|---|---|
| **ID** | **Category** | **Information Need/Gap** | **What** | **Where** | **Enabling Technologies** | **Partners** |
| 140 | Archeology | Natural history of Hawaiian Islands | Geological controls on marine biota | Hawaiian archipelago; surrounding pelagic waters; NW Hawaii - French Frigate Shoals; SE Hawaii - Big Island | Standard Package; airborne hyperspectral surveys; ground truthing; multi-platforms; mobile observatories | Standard Partners; Japan Marine Science and Technology Center (JAMSTEC) |
| 132 | Benthic Environment | Infaunal organisms | Taxonomy; Sediment ecology | Compare Northwestern Hawaii to others down chain; different depths; soft bottom | Standard Package; Sampling; multibeam; coring | Standard Partners |
| 135 | Benthic Environment | Characterization of bottom habitats | Broad scale characterization; match fish species to bottom characteristics; collect ground truth with deep tow side scan sonar; seafloor sediments characteristics; bottom currents | Samoa; Mariana's Islands | Standard Package; ROVs fly through canyon fishing; swath; deep tow; remote sensing of shallow areas; acoustic surveys | Navy; WHOI; University of Hawaii |
| 143 | Boundary Fluxes - Air/Sea | Climate change | Feedback of ocean change on biota -through observation approach time series with El Niño events: determine impacts on equatorial Pacific biological pump; long term; carbon fluxes in thermocline | Equatorial Pacific S. America; Galapagos; Toca Tao Arrays | Genetic sampling; satellite (remote sensing); mass spectrometer; sediment traps/cameras; fluorescent signal of phytoplankton species | Standard partners |
| 110 | Currents & Water Masses | Current patterns and gyres and how they are changing | Food production; marine debris deposits; how do they change and how are they affected? (larval transport) | HI Archipelago - large system focus | Satellites; Time observations; Floating instruments; Physical oceanography; Molecular techniques to look at long-term dispersal patterns | Standard Partners |
| 111 | Currents & Water Masses | Internal waves | Physical oceanography; internal tides | Sea mounts - 2002 proposal sites | ADCP; long-term moorings | Standard Partners |
| 119 | Ecosystem | Identifying ecologically critical habitats | Temporal / spatial observations; mapping; then direct observations; diversity; location; substrate type; visual information; reflected imagery; community structure; locating critical habitats with Critter Cam (animal borne camera) system; use existing and historical information | Intermediate depth regions; wide range of depths - mostly moderate depths to deeper depths; NW HI Islands - 2002 sites as specified in 2002 proposals; US Pacific Insular Islands; Guam; Samoa; CNMI | Standard Package plus; ADCP; current meters; multibeam; Same as tagging technologies; archival capability | Standard partners plus outreach partners, fishermen, National Geographic, Discovery Channel; recreational divers |

| Hawaii Workshop Results | | | | | | |
|---|---|---|---|---|---|---|
| **ID** | **Category** | **Information Need/Gap** | **What** | **Where** | **Enabling Technologies** | **Partners** |
| 109 | Ecosystem - Banks & Basins | Banks | Survey; map; ground truthing; sampling; direct observations; ID and characterize organisms as well as features | Penguin Banks; NW HI Banks | Standard Package; genomic technologies; coring; molecular techniques; video live feeds for outreach; HUGO at Loihi volcano; dating technologies | Standard Partners, HUGO, telephone companies, outreach partners, National Geographic, Discovery Channel, drug companies, MMS |
| 108 | Ecosystem - Basins & Banks | Solution Basins | Survey; map; ground truthing; sampling; direct observations; ID and characterize organisms as well as features | Off Maui | Standard Package; genomic technologies; coring; molecular techniques; video live feeds for outreach; HUGO at Loihi volcano; dating technologies | Standard partners, HUGO, telephone companies, outreach partners, National Geographic, Discovery Channel, drug companies, MMS |
| 106 | Ecosystem - Canyons | Submarine canyons | Survey; map; ground truthing; sampling; direct observations; ID and characterize organisms as well as features; carbon cycling; areas of high productivity; ID and characterize communities; maps | Kaneohe Canyons; Haleiwa Canyon; Waimea Canyon | Standard Package; genomic technologies; coring; molecular techniques; video live feeds for outreach; HUGO at Loihi volcano; dating technologies; bait deployment | Standard Partners, HUGO, telephone companies, outreach partners, National Geographic, Discovery Channel, drug companies, MMS |
| 107 | Ecosystem - Seamounts / Ridges | Seamounts | Locating unknown seamounts; identify and characterize communities; identify new species; altimetry mapping comparisons; geoid products; deep seamount biomass understanding; survey; map; ground truthing; sampling; direct observations with moored stations & deep dives; verifying location; sampling; mapping; deep scattering layer over hydro plumes | Northwestern Hawaii to start comparing altimetry w/ navigation charts; West Mounts; Necker Ridge; Hawaiian Islands; Musician Seamounts and then look outside to examine dispersal; evolution; many seamounts have no names; Emperor Seamounts | Standard Package; genomic technologies; coring; molecular techniques; video live feeds for outreach; HUGO at Loihi volcano; dating technologies; better altimetry sensors and data processing; improved spatial coverage; altimetry maps; swath bathymetry; gravity survey; fishing boat watching | Standard Partners, HUGO, telephone companies, outreach partners, National Geographic, Discovery Channel, drug companies, MMS; NESDIS; NASA; Navy |
| 144 | Ecosystem - Trenches | Trenches | Tonga Trench; deep dive mapping; gas hydrates | Mariana's Trench; Tonga Trench | Extreme deep diving for ROVs; sampling tech | JAMSTEC; NSF – Margins Program |

| Hawaii Workshop Results | | | | | | |
|---|---|---|---|---|---|---|
| **ID** | **Category** | **Information Need/Gap** | **What** | **Where** | **Enabling Technologies** | **Partners** |
| 138 | Ecosystems - Arc | Gaps in exploration in past of arcs | Standard plume techniques at Tonga Kermadec; less than 2% been explored; location of chemical fluxes and plumes; biota; volumetric; geologic signatures; tracing ocean circulation; sensing water column | Euphotic zone in Tonga Kermadec Arc | Standard Package: Airborne remote sensing surveys; expendable bathythermographs (XBTs); high precision; standard package; tow-yo | PMEL; Geologicaland Nuclear Sciences Limited (GNS); JAMSTEC; NSF - Ridge Program; American Samoa; NMFS; NMS |
| 120 | Extreme Environments - Vents, Seeps & Volcanoes | Formation of biofilm/microbial mat in extreme environments | Diversity; members of consortia; genome mapping; discovery of new antibiotics; chemistry of the environment | Loihi hydrothermal vent; New Zealand; Mariana's Trench; any extreme environment | Coring technology; Genomic; protein chemistry; microchip; confocal microscopy; develop portable confocal for ship use; small gc/ms; subs and other collection vehicles | Standard Partners |
| 122 | Extreme Environments - Vents, Seeps & Volcanoes | Active volcanism | General mapping; Access naval data; Airborne geochemical; Seismic; Passive acoustics; track plumes and trace elements from plumes from air; set up listening arrays; locate features using mapping technology | Am. Samoa; New Zealand; Japan; CNMI; Guam - throughout Pacific | Standard package plus remote sensing; thermal technology; magnetometers; seismology; acoustic technology; mapping technology; passive acoustic arrays; live feed for outreach | Standard partners, Navy, National Geographic, Discovery Channel, deep sea mining community, New Zealand, Japan, Island Nations, Indonesia, Australia, maritime industry, biotech, minerals |
| 133 | Extreme Environments - Vents, Seeps & Volcanoes | Understand the Pacific Ocean regarding the origin of life (vent communities, any optimal environments, etc) - A. Funnel (including Tow-Yos) | Interaction between geology; biota; circulation area to target (Tow-Yos - sampling in vertical) | Loihi - volcano; hot spot; Juan de Fuca; cold seeps; Back Arc Basins (Guam; Samoa; Lau) | Standard Package; specific sampling; HDTV; digital camera systems; sampling and incubation systems for culturing organisms | JAMSTEC, University of Washington, PMEL, NASA, GNS, Center of Marine Biology at Maryland (COMB) |
| 142 | Extreme Environments - Vents, Seeps & Volcanoes | Sample and map new hot spots; fundamental understanding | Investigate Loihi; Samoa; Louisville Ridge; sampling deep mantle plume; sample volcanic edifice edge of seafloor | Samoa; Loihi | Standard Package; ocean bottom observatories; SOSUS; Sonobuoys Ocean Bottom Seismometer; Acoustic | SOSUS; Isla - Infra Sound Lab (U.N.); HUGO; USGS; GNS |

| Hawaii Workshop Results | | | | | | |
|---|---|---|---|---|---|---|
| **ID** | **Category** | **Information Need/Gap** | **What** | **Where** | **Enabling Technologies** | **Partners** |
| 112 | Geology & Geomorphology | Paleoshorelines | Sea level information such as history; finding wave notches; ledges; other geomorphological features; lava tubes and marine caves - biology | HI Archipelago (focus in NW and main islands - Midway; Oahu; Necker; Brooks; Lisianski) | Coring technology; Advanced diving; Subs and other vehicles; multibeam for mapping; Animal borne instrumentation | Standard Partners |
| 127 | High Resolution Bathymetry | Charting of seamounts and banks | Mapping with more sophisticated technology | All submerged banks; particularly those that can't be seen through aerial photography; Northwestern Hawaii at 25-100 fathoms | Standard Package with multibeam | Standard Partners |
| 116 | Human Impacts | Pollution and marine pathogens | Use pathogen count as a marker | Event driven; Kaneohe Bay; Pearl Harbor; sewage outfall | Molecular biology techniques; genomic | Standard Partners |
| 131 | Human Impacts | Safe nuclear waste disposal site | | | | Standard Partners |
| 141 | Human Impacts | Understanding biomagnification of pollutants and toxins in the marine food web (similar to large pelagic) | Reef fishes; quantifying toxins | Kona coast; Ecuador; Peru; Alaska | Tracer technologies; genetic markers; sampling and ID tools; stable isotopes will vary; stable isotopes; fatty acid analysis; modeling | Standard Partners; EPA |
| 115 | Marine Microorganisms | Marine parasite lifecycles | Documenting parasites; life cycle; primary and secondary hosts | Compare regions to look for pollution relationships; Northwest Hawaii | Fishing; sampling technology; subs; genomic; histopathology; specimen collection | Standard Partners |
| 129 | Marine Microorganisms | Marine viruses | What are the effects on carbon and phosphorus cycling? | Oahu; Station Aloha (permanent sampling site - mooring) | Water sampling, virology, bacteriology, molecular biology techniques | Standard Partners |

| Hawaii Workshop Results | | | | | | |
|---|---|---|---|---|---|---|
| **ID** | **Category** | **Information Need/Gap** | **What** | **Where** | **Enabling Technologies** | **Partners** |
| 118 | Marine Organisms | Animal distribution patterns | Opportunistic (fisheries) adults-only tagging through existing operations such as fishing industry; targeted adult tagging - mark-recapture of marine mammals; photo identification; track over time with tags and acoustic moorings; genomics (can be part of tagging and/or tracking); collect tissue and analyze; otolith elemental fingerprinting - collect specimens through HI Arch. and analyze; larval distribution patterns - collect and identify samples | HI Archipelago (Hoomalu and Mau regions - have at least one site in each region; also big island site); specific relationship between main HI and NW HI and between Johnston Atoll to S. Japan; island to island; bank to bank relationships | Standard Package; RAPT system for tracking; tags; cameras; tracking devices; genomic; develop new faster genomic technologies to be used on ships; current meters; ADCP; molecular techniques to identify larvae; aerial survey; digital ID tools; fingerprinting technology; plankton tows | Standard Partners; plus fishermen - recreational and commercial |
| 121 | Marine Organisms | New species/records inventory | Identify new species through existing expeditions recording abundance and diversity; taxonomy; going to areas and habitats that are not well documented | Northwest Hawaiian Islands (NWHI) (2002 proposal sites) - far islands such as Kure and beyond where there have been no subs thus far; get close to N Pacific transition zone; US Insular surveys; maybe look at some equatorial areas for comparison | Standard Package; Plus molecular and genomic techniques; Coring technology; Advanced diving; Subs and other vehicles; multibeam for mapping; Animal borne instrumentation | Standard Partners plus fishermen, Smithsonian, New Species Consortium, Sloan Foundation, National Geographic, Discovery Channel, Packard Foundation |
| 128 | Marine Organisms | Coelacanth, giant squid, megamouth (obscure, unknown critters) | Location; habitats; population distribution; abundance; genetics; images | Indonesia (coelacanth); HI; California (Pacific) (megamouth); New Zealand (giant squid) | Standard Package; Imaging; Subs; ROV's | Standard Partners |
| 134 | Marine Organisms | Marine biodiversity - inventory from Hawaii Islands - Deep Marine (>200m - ~6500m or beyond) | Along and around Hawaiian Ridge & link investigators to coordinate discovery | NW Hawaiian Islands to compare species; deep ocean areas | Standard Package; Observatories at depth; deep ocean sampling instruments; low light cameras; video; acoustics; AUVs; deep submersible; ROVs; benthic observatories; in-situ observatories; self cleaning camera lenses; Critter Camera technology; rugged low light cameras | Standard Partners; JAMSTEC; ONR; National Geographic; NMFS; US Fish & Wildlife Service |

| Hawaii Workshop Results | | | | | | |
|---|---|---|---|---|---|---|
| **ID** | **Category** | **Information Need/Gap** | **What** | **Where** | **Enabling Technologies** | **Partners** |
| 139 | Marine Organisms | Understand habitat of large pelagic animals | Migration corridors; use of ocean; vertical movements - targeted & observational commercial/research vessels for tagging; satellite data comparisons for behavior patterns; acoustic subsurface surveys (foraging) by attaching instruments to animals - movements; fronts; eddies; interaction with benthos; linking foraging with physical environment | Central Pacific (around Hawaii); coastal Kona (Big Island); ship of opportunity; Hawaiian Ridge | Standard Package; Critter Cam technology; satellite archival tags; ARGOS; remote sensing; acoustic surveys; instrument research technologies attached to animals | Standard Partners; Fishery Management Council; Hawaii Longline Assoc; National Fish & Wildlife; National Geographic; National Institute of Water and Atmospheric Research (NIWA - New Zealand); Commonwealth Scientific and Industrial Research Organisation (CSIRO - Australia); South Pacific Regional Environment Program (SPREP) |
| 126 | Ocean Resources - Energy & Minerals | Mineral resources | Location; composition | Johnston sea mount; other sea mounts | Standard Package; multibeam | Standard Partners |
| 123 | Sound in the Ocean | Ocean acoustics | | Hawaii Archipelago (Northwestern and main Hawaii mapping); Guam; Commonwealth of the Northern Mariana Islands (CNMI); American Samoa; deeper areas | Sonar - active and passive; use subs and other vehicles for in-situ measurements; archival measurements | Standard Partners |

**Hawaii Region Exploration Targets of Interest**

1. Emperor Seamounts
2. French Frigate Shoals
3. Guam
4. Haleiwa Canyon
5. Indonesia
6. Johnston Atoll
7. Kaneohe Bay / Kaneohe Canyons
8. Kure
9. Lanai
10. Loihi
11. Marianas Islands
12. Marianas Trench
13. Marquesas
14. Midway
15. Musician Seamount Province
16. Necker Island
17. New Zealand
18. Nihoa Island
19. Oahu
20. Pearl Harbor
21. Penguin Bank
22. Samoa
23. Station Aloha [45.00' N, 158 00.00] (not on chart)
24. Toga Tao Arrays (not on chart)
25. Tonga Kermadec Arc
26. Waimea Canyon
27. West Mounts

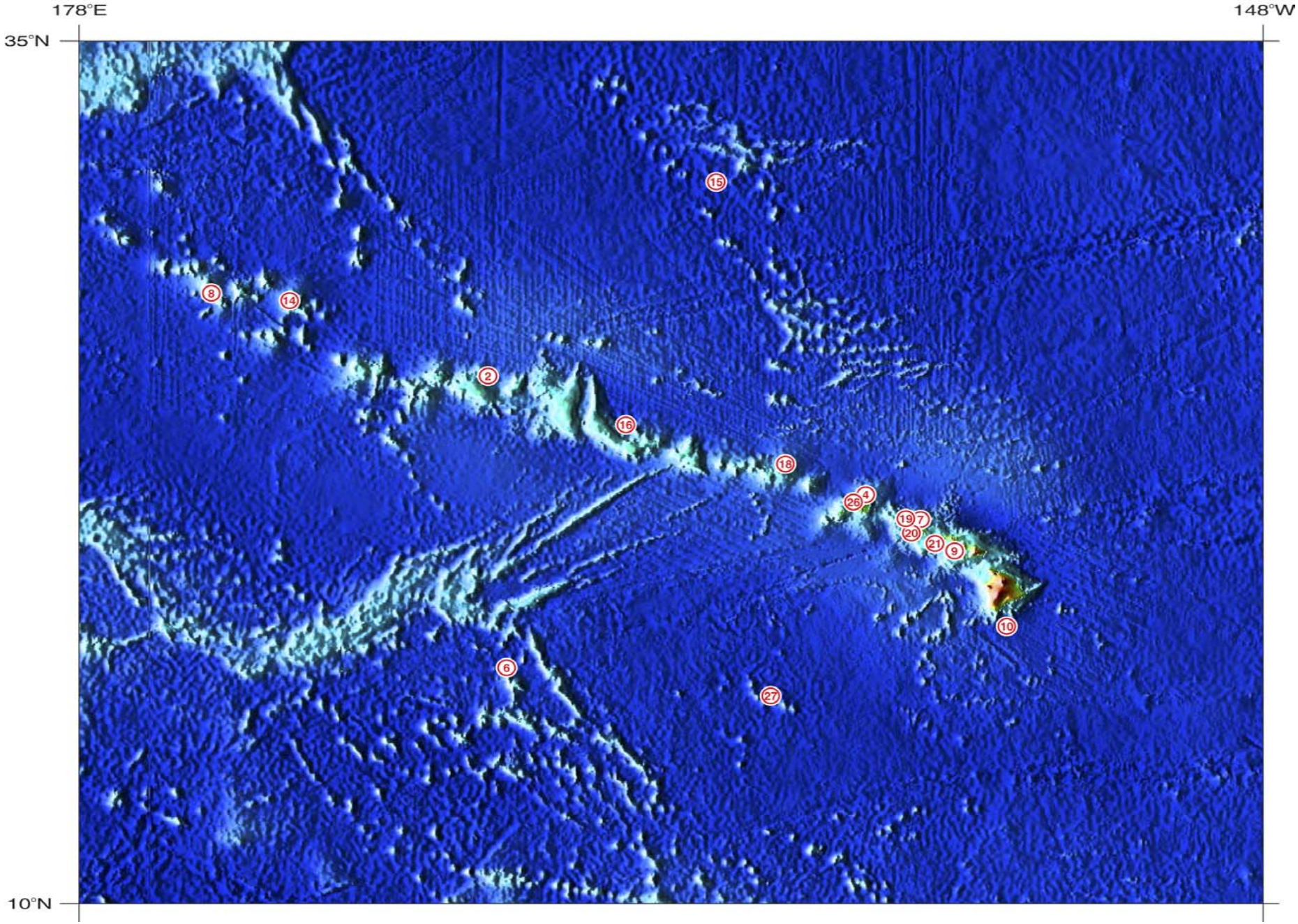


**Figure 3-3. Hawaii Region Exploration Targets of Interest – Vicinity of Hawaii**

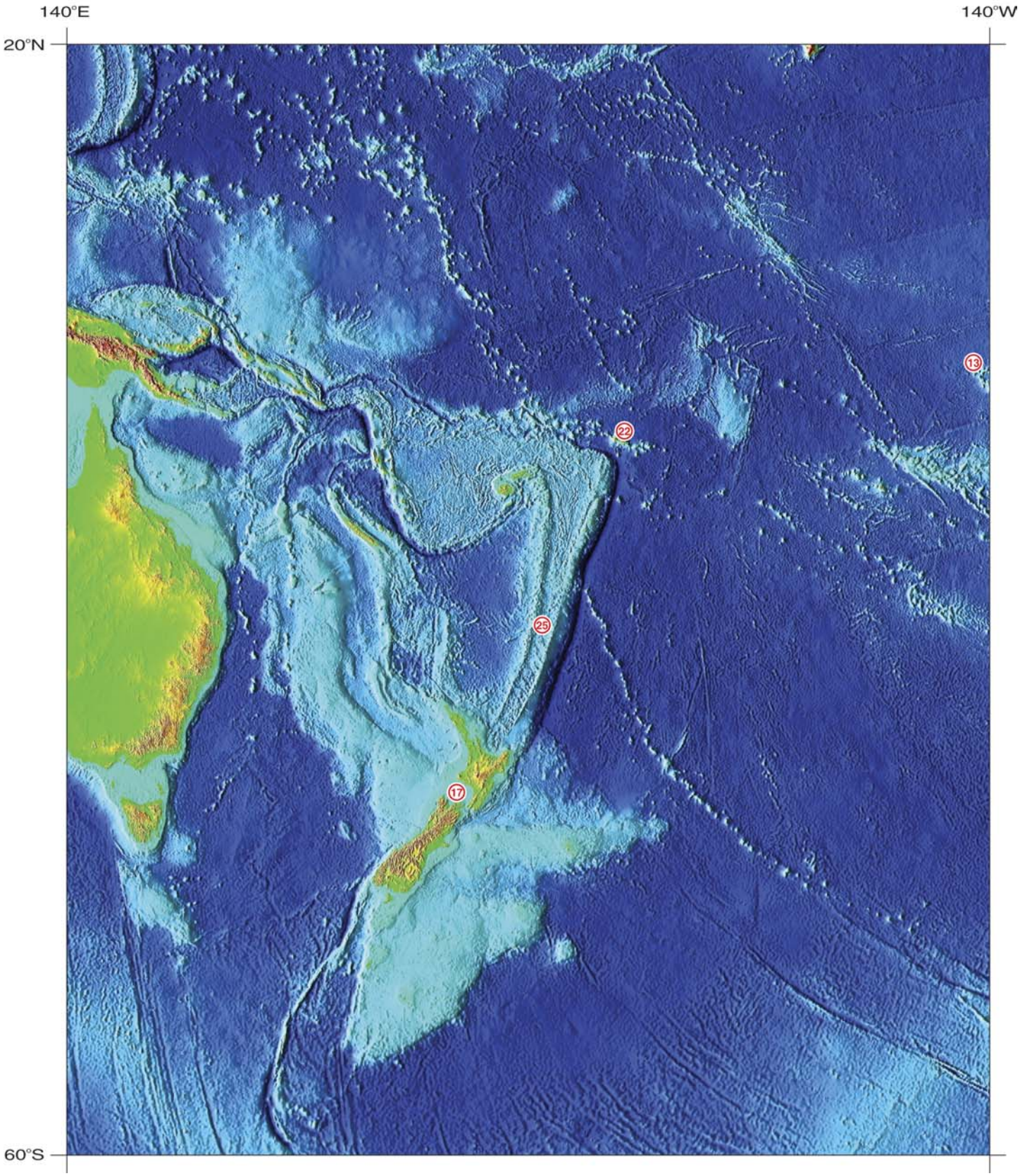


**Figure 3-4. Hawaii Region Exploration Targets of Interest – South Pacific**

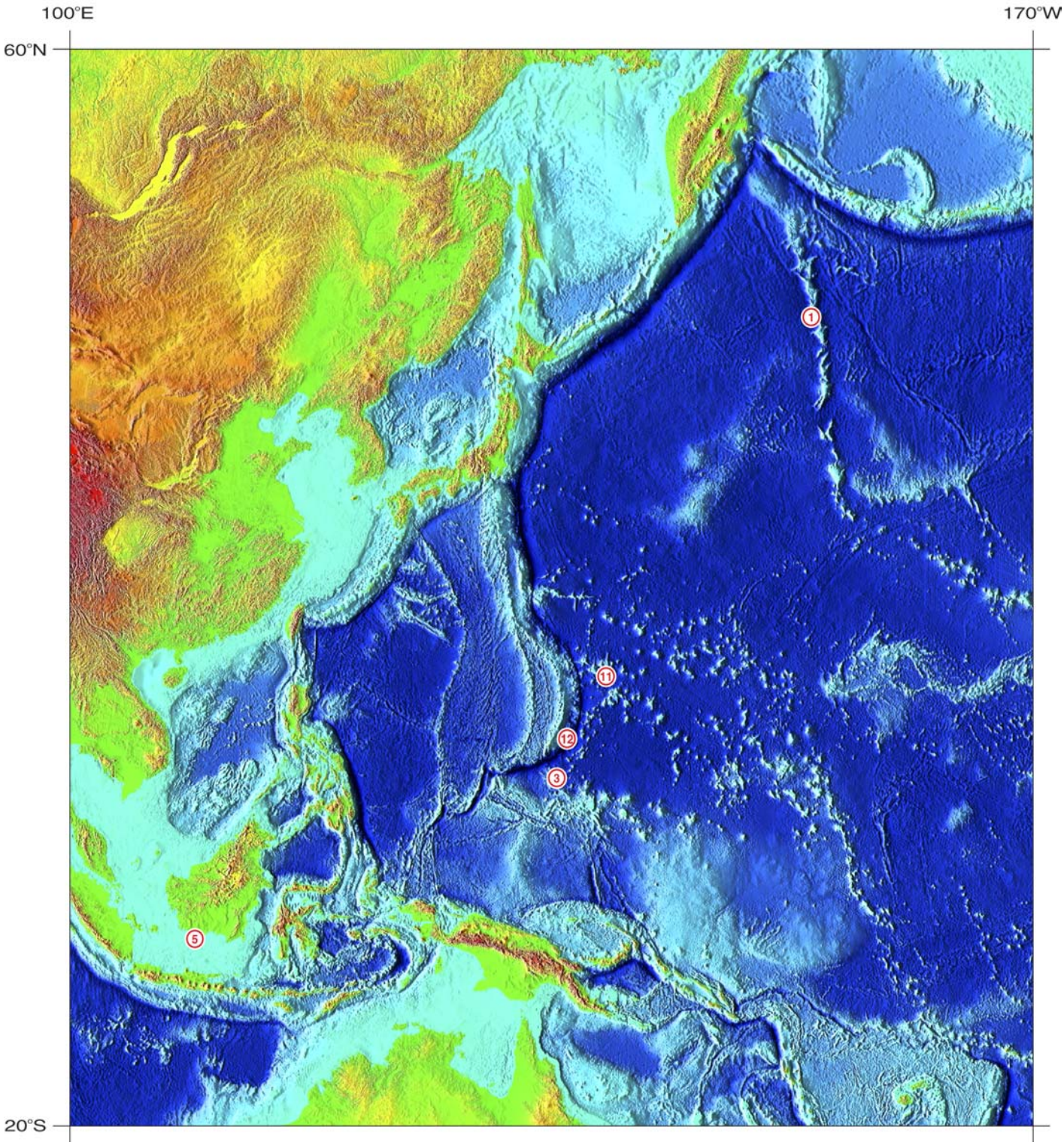


**Figure 3-5. Hawaii Region Exploration Targets of Interest – Western Pacific**